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EMISSIONS OF NO_x, SO_x, AND VOC FROM ANTHROPOGENIC SOURCES

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16. ABSTRACT The paper addresses the compilation of a 1980 emissions inventory for use in the National Acid Precipitation Assessment Program (NAPAP). The current inventory (Version 4.0) contains point source data for 50,200 plants with more than 201,000 emission points and area source data for the 3,069 counties in the 48 contiguous States and the District of Columbia. Emissions of SO2, NOx, VOC, sulfates, ammonia, CO, and particulates are included in the inventory, but the paper focuses on SO2, NOx, and VOC which are of primary interest for acid deposition research. NAPAP Version 4.0 emissions of SO2, NOx, and VOC are 27.1, 23.7, and 23.3 million tons per year, respectively. Emissions in the NAPAP data base are in reasonable agreement with the U.S./Canada Work Group 3B and the EPA Office of Air Quality and Standards emissions trends estimates. NAPAP fuel use data show reasonable agreement with fuel values in DOE's State Energy Data Report. Version 4.0 of NAPAP represents the best detailed inventory of emissions on a national scale that has been developed to date. Nevertheless, additional improvements are planned, focusing on major point sources.

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Inventories	Organic Compounds	Acid Rain	15E	07C
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ABSTRACT

This paper addresses the compilation of a 1980 emissions inventory for use in the National Acid Precipitation Assessment Program (NAPAP). The current inventory (Version 4.0) contains point source data for 50,200 plants with over 201,000 emission points and area source data for the 3,069 counties in the 48 contiguous States and the District of Columbia. Emissions of SO_2, NO_x, VOC, sulfates, ammonia, CO, and particulates are included in the inventory but this paper focuses on SO_2, NO_x, and VOC which are of primary interest for acid deposition research. NAPAP Version 4.0 emissions of SO_2, NO_x, and VOC are 27.1, 23.7, and 23.3 million tons per year, respectively. Emissions in the NAPAP data base are in reasonable agreement with the U.S./Canada Work Group 3B and the EPA Office of Air Quality Planning and Standards (OAQPS) emissions trends estimates. NAPAP fuel use data show reasonable agreement with fuel values in DOE's State Energy Data Report. Version 4.0 of NAPAP represents the best detailed inventory of emissions on a national scale that has been developed to date. Nevertheless, additional improvements are planned focusing on major point sources.

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INTRODUCTION

In 1980, Congress established NAPAP to coordinate and expand research relevant to the problems posed by acid deposition in and around the United States. The program is organized and managed through the Interagency Task Force on Acid Precipitation (ITFAP) and 10 subordinate task groups coordinating specific technical areas of research. One of the groups is Task Group B which is responsible for anthropogenic sources. A major objective of Group B is the development and maintenance of detailed emission inventories to support acid deposition research and analysis.

The objectives of the effort summarized herein were to develop the initial 1980 base year emission inventory, evaluate its quality and comprehensiveness, and identify actions needed for further refinement of the data base in the future. The project required development of a central, quality-assured data base of emissions of pollutants of interest for acid deposition research and modeling. The area covered includes the 48 contiguous States of the U.S. and the District of Columbia.

DISCUSSION

Version 4.0 of the NAPAP data base was developed starting with 1980 "snapshot" information from the U.S. Environmental Protection Agency's (EPA's) National Emissions Data System (NEDS). The initial data base was improved by incorporating the latest available emission factors, substitution of data from the Northeast Corridor Regional Modeling Project and other NEDS data more representative of 1980, updating electric utility data with the U.S. Department of Energy (DOE) data compiled by E.H. Pechan and Associates, cross-checking data with information from the U.S./Canada Work Group 3B report, and adding county

centroid latitude and longitude for sources with missing or incorrect Universal Transverse Mercator (UTM) coordinates. The NAPAP data are stored in Emission Inventory System (EIS) format on the EPA's IBM computer at Research Triangle Park, North Carolina.

NAPAP data show that SO_2 emissions are dominated by electric utilities, primarily from coal-fired generating stations located in the eastern U.S. For NO_x, the largest sources are transportation (mostly highway vehicles), electric utilities, and industrial combustion. For VOC, emissions result largely from transportation (again primarily highway vehicles), other industrial processes, and miscellaneous sources which include organic solvent use not accounted for by point sources, retail gasoline service stations, and forest wildfires.

The geographic breakdown of SO_2 emissions in NAPAP indicates that EPA Regions 4 and 5 are the largest contributors. The eastern 31 States account for over 82 percent of nationwide SO_2 emissions. For NO_x, Regions 4, 5, and 6 are the highest emitters, with the eastern 31 States accounting for about 64 percent of national emissions. Regions 4, 5, and 6 are also responsible for the greatest amount of VOC emissions. The eastern 31 States account for 66 percent of the nation's VOC emissions.

The relative importance of point versus area source emissions varies for each of the three pollutants. Point sources contribute over 90 percent of national SO_2 emissions. For NO_x, emissions are nearly evenly distributed. Area sources, on the other hand, emit almost 80 percent of total VOC emissions. Ohio, Pennsylvania, and Indiana have the greatest SO_2 emissions. Texas, California, and Ohio are the greatest NO_x emitters, while Texas and California have the greatest VOC emissions.

Seasonal variations were derived from operating data in the point source inventory and seasonal factors added to the area source file. Seasonal variations are less than expected. For SO_2, the maximum variation is 3 percentage points, from 24 to 27 percent. The maximum variation for NO_x and VOC is only 2 percentage points, from 24 to 26 percent. Emissions of SO_2 and NO_x are greatest in winter and lowest in spring. VOC emissions are the highest in summer and lowest in winter.

Although it is effective plume height that is of greatest interest to modelers, only stack height data are included in NAPAP. Thus, only emissions by stack height range could be summarized. These data show that nearly all VOC emissions (both point and area) are emitted below 120 feet (36.6 m). Over two-thirds of the total emissions of NO_x also are released below 120 feet. On the other hand, nearly 40 percent of all SO_2 is emitted at heights above 480 feet (146.3 m).

County emission densities were calculated and density ranges summarized to obtain more information on the concentration of emissions. For SO_2, counties in the highest emission density range result from power plants located in the East, primarily in the Ohio Valley and Great Lakes areas. These counties represent only 4 percent of those in the nation but have 54 percent of the total emissions. For NO_x, the counties in the highest range result from either power plants or highway vehicles. These counties represent only 3 pe t of those in the nation but contribute 27 percent of the total emissions. For VOC, the counties in the highest range result from solvent use and highway vehicles. These counties represent only 2 percent of all counties in the nation but contribute 29 percent of the total emissions.

A comparison of NAPAP, Trends, and Work Group 3B emissions of SO_2 and NO_x shows reasonable agreement. NAPAP total SO_2 emissions are greater than Work Group 3B by 3 percent and than Trends by 5.5 percent. NAPAP and Work Group 3B/Trends emissions compare well for all categories except nonutility combustion. NAPAP total NO_x emissions are greater than Work Group 3B by 11.8 percent and greater than Trends by 4 percent. The greatest difference between NAPAP and Work Group 3B occurs for the electric utility category. The differences between NAPAP and Trends occur for the electric utility, nonutility combustion, and transportation categories. Some of the variation for utilities is a result of fuel differences, but most is likely to be caused by different emission factors and control efficiencies. The nonutility combustion category variation occurs for the same reasons as the variation in the utility category except that the nonutility category may be more affected by fuel differences. The transportation category variation occurs because more detailed traffic data, available only on a nationwide basis, are used in developing the Trends estimate.

CONCLUSIONS

Version 4.0 of NAPAP represents a detailed inventory of emissions on a national scale for the 1980 base year. Over 80 percent of the NAPAP emissions truly represent 1980. Over 90 percent are in the range from 1978 to 1981. Many of these large emitting facilities are electric utility plants and nonferrous smelters for which extensive quality assurance efforts have already been performed. About 80 percent of point source SO_2 and NO_x emissions occur at sources with complete stack data and valid UTM coordinates.

Future resources will be used to try to improve NAPAP to meet the needs of Eulerian modeling activities. Additional quality assurance efforts are planned for the 1980 data base focusing on major point sources. Additional pollutants not now in NAPAP, speciation of VOC and NO_x emissions, hourly temporal resolution of emissions, and spatial resolution of data into small grid zones covering the entire U.S. will be required. Other activities include incorporation of emission data for Canada into NAPAP, coordination with Task Group A to include natural emission sources in NAPAP, and a statistical evaluation of the uncertainty of NAPAP emission estimates.

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